

• Practice graphing systems of linear inequalities by using colored pencils to effectively show the solution as a shared area. Remind students that the presence of an “or equal to” symbol has an effect on the graph of each linear inequality. A solid line indicates that the line itself is part of the solution and a dotted line shows that the line is not part of the solution.

• Solving absolute value inequalities is often challenging. Show students that absolute value inequalities can be rewritten as compound inequalities. A “less than” absolute value inequality can be rewritten as an intersection, while a “greater than” inequality can be rewritten as a union:

$$|x + 2| < 7 \text{ is equivalent to } -7 < x + 2 < 7$$

$$|x - 4| > 8 \text{ is equivalent to } x - 4 < -8 \text{ or } x - 4 > 8$$

• Introduce the graphs of quadratic inequalities by having students explore the tutorial at www.algebralab.org/studyaids/studyaid.aspx?file=Algebra1_9-6.xml. Working in small groups, students can discuss similarities and differences between the graphs of linear and quadratic inequalities.

Using a Calculator

A graphing calculator can quickly and accurately graph a linear inequality or a system of linear inequalities. Make sure students understand how graphs are shaded on their graphing calculators, since graphing calculators often have specific rules for setting lower and upper boundaries in order to have properly shaded graphs. Before starting, on many calculators, you must clear any preexisting functions from the (Y=) list. Then, use the (DRAW) function. Please note that many calculators will display a solid line at all times. You will have to determine whether a solid line or dashed line is appropriate for the linear inequality.

Different calculators often require different keys or key strokes to perform an operation. Sometimes the primary function of a key on one calculator appears as the secondary function of a key on another calculator. Encourage students to practice performing different operations on their calculators. Getting to know how their own calculator works is an important part of being a savvy algebra student.

Suggested Internet Resources

Periodically, Internet Resources are updated on our web site at www.LibraryVideo.com.

- www.algebralab.org/studyaids/studyaid.aspx
This web site has tutorials in many areas of mathematics, including several for linear inequalities in the “Linear Equations” section.
- www.regentsprep.org/Regents/math/ALGEBRA/AE85/indexAE85.htm
This web site from the Oswego City School District offers lessons, practice questions for students, and teacher resources about the graphs of linear inequalities.
- www.wtamu.edu/academic/anns/mps/math/mathlab/int_algebra/int_alg_tut17_linearin.htm
This tutorial from West Texas A&M University offers step-by-step instructions on how to graph linear inequalities.

Suggested Print Resources

- Great Source Education Group. *Algebra to Go: A Mathematics Handbook*. Great Source Education Group, Wilmington, MA; 2000.
- Muschla, Judith A. and Gary Robert Muschla. *Algebra Teacher's Activities Kit: 150 Ready-to-Use Activities with Real-World Applications*. John Wiley & Sons, Incorporated, Hoboken, NJ; 2003.
- Wingard-Nelson, Rebecca. *Algebra I and Algebra II*. Enslow Publishers, Berkeley Heights, NJ; 2004.

TEACHER'S GUIDE

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Algebra

for Students.

Analyzing Inequalities

Grades 7-12

In algebra, students are challenged to make a leap, from the concrete world of numbers and real objects, to an abstract one of letters and symbols. *Algebra for Students* is designed to help students to become more comfortable in the abstract world of algebra through the exploration of problems in the real world, from using a system of linear equations to calculate the cost of a sushi roll to using a quadratic function to describe the path of a kicked football. Animated graphics, real-life locales and vibrant young hosts help to explain math concepts, highlight multiple ways of approaching a problem, illustrate common pitfalls to avoid and tackle some typical test questions.

This guide provides a program overview, background knowledge needed for understanding, vocabulary, discussion questions and activities, tips for using a calculator, as well as print and Internet resources to supplement the teaching of targeted algebra concepts.



Program Overview

Phrases like *more than*, *less than*, *between* and *greater than or equal to* are found in inequalities — mathematical sentences that compare the values of expressions. Many common real-life situations, like the number of people standing in line for a concert or the range of temperatures suitable for an outdoor event, can be represented using inequalities. A simple inequality is a comparison of two expressions using an inequality symbol. A compound inequality may be an intersection, a joining of two simple inequalities with the word *and*, or a union — a joining of two simple inequalities with the word *or*. Simple and compound inequalities can be graphed using a number line.

Linear inequalities are solved in a similar way as linear equations — isolate the variable on one side of the equation using arithmetic operations and the properties of equality. One important difference occurs when multiplying or dividing by a negative number. When solving a linear inequality, the inequality sign must be reversed if both sides of the inequality are multiplied or divided by a negative number.

To graph a linear inequality, graph the corresponding linear equation. This is the boundary line. Then, determine whether the line should be solid or dashed. If the inequality contains the \leq or \geq symbol, a solid line is used to show that the boundary is included in the graph. If the inequality contains the $<$ or $>$ symbol, a dashed line is used to show that the boundary line is not included in the graph. Finally, shade the side of the line containing the solutions to the inequality. It is a good idea to check your solution by substituting coordinates of one or two points in the shaded region back into the original inequality. A system of linear inequalities is graphed in a similar way. The shaded area representing the solutions to the system of inequalities will occur *between* the lines of the corresponding linear equations.

Background

Before studying the content discussed in the video, students should be able to:

- Translate words and phrases into mathematical equations.
- Solve equations in one variable.
- Use slope-intercept form to graph a linear equation.
- Graph horizontal and vertical lines on a coordinate plane.

Vocabulary

inequality — A mathematical sentence comparing the values of expressions using $<$, \leq , $>$, \geq or $=$.

compound inequality — Two inequalities connected by the words *and* or *or*.

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intersection — A compound inequality containing the word *and*. For example, the compound inequality $7 < x$ **and** $x < 14$ (also written $7 < x < 14$) is an intersection.

union — A compound inequality containing the word *or*. For example, the compound inequality $x \leq 5$ **or** $x > 12$ is a union.

linear inequality — A first degree polynomial inequality. For example, $y \geq 9x - 4$ is a linear inequality.

system of linear inequalities — Two or more linear inequalities that contain the same variables and share a common solution.

Pre-viewing Discussion

- Mathematical inequalities are all around us. Give students five minutes to write as many inequality statements as they can that describe events or situations in the real world around them. For example, the inequality $15 > 12$ can describe a class of 27 students that has three more girls than boys. Challenge them to come up with statements that can be expressed with only the \leq or \geq symbols. When time is up, ask them to share the list of inequalities they generated.
- As a warm-up, provide students with a word problem involving a linear equation to solve. Linear inequalities are solved in a similar way as linear equations, so students should have a solid understanding of how to solve simple and multi-step linear equations.
- Show students a graph of a linear inequality. Place a graph of its corresponding linear equation beside it. Ask students to compare and contrast the two graphs and use what they know about the graphs of linear equations to determine what is different about the graph of the linear inequality. Generate a list of questions about linear inequalities based on this exercise. Return to this list after viewing the program.

Problems

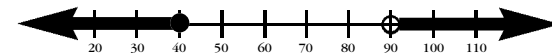
1. At Math Valley Middle School, each homeroom must have at least 20 students but no more than 32 students. Write a compound inequality describing the situation.
2. The football team must practice inside when the outside temperature is higher than 90 degrees or lower than or equal to 40 degrees. Write an inequality describing the situation and graph the inequality on the number line.
3. The sum of a number and 12 is less than 20. Write an inequality describing the situation, solve the inequality, and graph the solution on a number line.

Solutions

1. Let x equal the number of students in a homeroom. The possible number of students in each homeroom must be at least 20 students ($x \geq 20$) and no more than 32 students ($x \leq 32$). The compound inequality representing the situation is $20 \leq x \leq 32$.
2. Let t equal the outside temperature. The football team must practice inside when the temperature is over 90 degrees ($t > 90$) or less than or equal to 40 degrees ($t \leq 40$). This situation can be represented by a union — a compound inequality containing the word *or*:

$$t \leq 40 \text{ or } t > 90$$

Now graph the solution on the number line:



3. Let n equal the number. The sum of the number and 12, $n + 12$, is less than 20, so the inequality $n + 12 < 20$ describes the situation. Now solve for n :

$$\begin{array}{r} n + 12 < 20 \\ - 12 \quad - 12 \quad \text{Subtract 12 from each side.} \\ \hline n < 8 \end{array}$$

The number is less than 8. Now graph the solution on the number line:



Follow-up Discussion & Activities

- The various inequality symbols and terms can be translated into numerous, different words and phrases. Have students create a chart with each inequality symbol or term ($>$, \geq , $<$, \leq , $=$, *and*, *or*, etc.) and a list of equivalent words or phrases. Students can keep the chart in their notebook or folder for easy reference.
- Use inequalities, including conjunctions and disjunctions, to describe the statistics of favorite local sports teams and their rivals. Then, have students show how these inequalities are represented on a number line graph. When should they use closed circles as endpoints? Open circles?
- A common mistake when solving inequalities is forgetting to reverse the inequality sign when multiplying or dividing by a negative number. Have students determine the correct solutions to inequalities like $-4x < 28$. Remind students to be careful when solving inequalities with negative signs, since the presence of a negative sign does not automatically mean the inequality sign is reversed. In the inequality $5x > -30$, the “greater than” sign remains in the solution because you are dividing by 5 (the fact that the dividend is a negative number does not mean the inequality sign is reversed).

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